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10/538,110	12/14/2005	Robert Frederick Milsom	GB 020223	8868

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EXAMINER	
SUMMONS, BARBARA	

ART UNIT	PAPER NUMBER
2817	

NOTIFICATION DATE	DELIVERY MODE
07/15/2008	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

ip.department.us@nxp.com

Office Action Summary	Application No.	Applicant(s)	
	10/538,110	MILSOM ET AL.	
	Examiner	Art Unit	
	BARBARA SUMMONS	2817	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *10 April 2008*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1 and 3-12* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1 and 3-12* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Specification and Claim Objections

1. The Examiner agrees that the more commonly used term in the United States "tungsten" should also "encompass what most of the world calls 'wolfram', specifically, the element with the atomic number 74, along with isotopes and alloys of that element as known in the art" as asserted by Applicants (see page 6 of the response received 4/10/08).

2. All prior objections to the specification and claims have been overcome by the response received 4/10/08, and they are therefore withdrawn.

Withdrawn Claim Rejections - 35 USC § 112

3. The amendment and persuasive arguments received 4/10/08 have overcome each of the prior § 112 rejections and they are therefore withdrawn.

Withdrawn Claim Rejections - 35 USC §§ 102 and 103

4. The Examiner agrees that the Weber and Zimnicki references disclose a solidly mounted film bulk acoustic resonator (FBAR) and not a "membrane structure FBAR" as now required by amended claim 1, and the prior rejections based on these references are therefore withdrawn.

5. Regarding the prior rejection of claims 1-3 and 12 based on the Bradley reference, the Examiner does agree that the one embodiment applied in the prior § 102 rejection does not particularly point out each feature of the invention on its own, and

therefore believes that the rejection should more appropriately have been a § 103 rejection. In order to clarify what the reference on its own discloses in terms of single embodiments and also suggests to those of ordinary skill in the art based on all the embodiments thereof, a new grounds of rejection under § 103 based on the Bradley reference will be applied below. Therefore, this Office action Will NOT be made Final.

New Grounds of and Maintained Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. § 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

7. Claims 1, 3 and 12 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Bradley et al. U.S. 6,874,211 (of record) taken alone.

Fig. 4 of Bradley discloses two FBARs on a substrate with slightly different resonant frequencies so as to form a filter (see e.g. col. 1, lines 45-54 and 66), the

FBAR 110 comprising a membrane structure over a cavity 111 and having a layer structure comprising a piezoelectric layer 114 and a top electrode 116 and a bottom electrode formed by a stack of conductive materials 113 and 112 wherein the layer 112 is 1,500 Angstroms thick the same as bottom electrode 122 of adjacent resonator 120 (see col. 7, lines 44-47) and the layer 113 adds anywhere from 100 to 1,000 Angstroms to the total thickness of the bottom electrode (see col. 7, lines 47-49).

However, the specific embodiment of Fig. 4 does not explicitly discuss the thickness of the top electrode 116, 126 of the resonators, such that the top electrode 116 is thinner than the bottom electrode 112+113.

Note that Fig. 4 of Bradley varies the resonant frequencies of the two resonators by mass loading the bottom electrode of one of the resonators 110 (col. 7, lines 6-7). In the extremely similar embodiment of Fig. 5A, the resonant frequencies of the resonators are made different by mass loading a top electrode instead of a bottom electrode (see col. 8, lines 5-6), wherein this embodiment clearly discloses that both the top and bottom electrodes 136 and 142 begin at a thickness of 1,500 Angstroms (see col. 9, lines 1-6) and then the mass loading layer 138 adding 100 to 1,000 Angstroms is provided (ibid.). This would have clearly suggested to one of ordinary skill in the art that in each of the embodiments, though not explicitly mentioned in the discussion of every embodiment, that the resonators in the 1900MHz range each begin with top and bottom electrodes with a thickness of 1,500 Angstroms and one of the resonators then has its frequency changed by e.g. mass loading the bottom electrode as shown in Fig. 4, which would have resulted in a top electrode 116 with a thickness of 1,500 Angstroms that is

thinner than the bottom electrode by 100 to 1,000 Angstroms being the added layer 113 added to the 1,500 Angstrom thick layer 112 (col. 7, lines 44-47). This is reinforced by the multiple mentions by Bradley of these 1,500 Angstrom thicknesses of both electrodes for 1900MHz resonators (see col. 3, lines 45-51 and col. 9, lines 1-4) as well as the mention of "initial" thickness of one of the top or bottom electrodes in another embodiment (see col. 6, lines 61-64) as well as thickness of the core initial electrode in the Fig. 4 embodiment (col. 7, lines 45-47). It should be noted that the Fig. 3A-B embodiment that thins the top electrode that was initially 1,500 Angstroms also provides a resonator with a thinner top electrode than a bottom electrode that is suggested to be initially 1,500 Angstroms by the reference as a whole.

Consequently, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified the resonators in the Fig. 4 embodiment of Bradley, if even necessary, such that the top electrodes 116, 126 would have also been 1,500 Angstroms thick as well as bottom electrode layers 112, 122 (col. 7, lines 45-47), because such an obvious thickness of the top electrodes being equal to the bottom electrodes initially, and remaining so for the untuned resonator 120 and with the resonator 110 then having a top electrode thinner than the mass loaded bottom electrode 112+113, would have been extremely well known to one of ordinary skill in the art and as much is in fact implicitly suggested by Bradley in multiple other embodiments (see col. 3, lines 45-51 and col. 9, lines 1-4), wherein one of ordinary skill in the art would have obviously carried these values for 1900MHz FBARs over into the alternative embodiments.

8. Claims 4, 5 and 7-9 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Bradley et al. U.S. 6,874,211 (of record) in view of Lakin U.S. 6,291,931 (of record).

Note that the reasons are mostly of record as stated in paragraph 11 of the prior Office action. The reasons are repeated below for Applicants' convenience with modifications for clarity or to address the claims as amended (note that the Lakin in view of Bradley portion of the prior rejection is no longer applicable and withdrawn).

Bradley discloses the invention as discussed above. However, Bradley does not show a conductive material 112 (Fig. 4) in contact with the piezoelectric layer having a higher acoustic impedance than the conductive material 113 not in contact with the piezoelectric layer (claim 5) with a diffusion barrier layer therebetween (claim 4) or the conductive materials being those recited (claims 7 and 8). Note that Bradley does disclose that its electrode materials with both 112 and 113 being the same material is only one "possible" embodiment (col. 7, lines 29-31).

Fig. 6 of Lakin discloses FBARs with bottom electrodes that are a stack of conductive materials 68 and 70, wherein the conductive material 68 that is in contact with the piezoelectric layer is tungsten (W), which inherently has a higher acoustic impedance than that of the aluminum conductive material 70 that is not in contact with the piezoelectric layer; and between the conductive layers are other very thin layers (see col. 5, lines 43-50) which one of ordinary skill would have known included diffusion barrier layers formed of the extremely well known material of titanium (Ti) would also would have been known in the acoustic resonator art to provide the desirable function of

adhesion between materials that do not bond well being a function also suggested by Lakin (see col. 5, lines 48-50).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified the filter of Bradley having resonators with a top electrode thinner than a bottom electrode (Figs. 3A-4), by having provided the electrode layers be stacks of conductors with a high acoustic impedance material of tungsten in contact with the piezoelectric layer and an aluminum conductive material not in contact with the piezoelectric layer, with a diffusion barrier layer therebetween a suggested by the exemplary teaching thereof by Lakin (Fig. 6 and Fig. 9b and col. 5, lines 45-50), because such an obvious modification would have provided the advantageous benefits of increasing the effective coupling coefficient by the use of a high acoustic impedance material e.g. tungsten and decreasing the electrical losses by the use of the outer layer with high electrical conductivity e.g. aluminum as suggested by Lakin (see the abstract), thereby providing resonators with reduced losses, both acoustic and electrical, and filters with wider bandwidths as also suggested by Lakin (see col. 2, lines 34-46), and also because Bradley clearly disclosed its electrode materials as only one possible embodiment (see col. 7, lines 24-31) suggesting that other materials as well (see col. 10, lines 22-27) such as those of Lakin would have been usable therewith.

9. Claims 4, 6 and 9 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Bradley et al. U.S. 6,874,211 (of record) in view of Zimnicki et al. U.S. 6,249,074 (of record)[cited by Applicants].

Bradley discloses the invention as discussed above, except for the diffusion barrier between stacked conductive electrode materials (claim 4) and the conductive material in contact with the piezoelectric layer having a lower acoustic impedance than the conductive material not in contact with the piezoelectric layer (claim 6).

Zimnicki discloses (see Fig. 2) that it would have been known to provide FBARs with stacked conductive electrode layers 14, 16 with a diffusion barrier 18 between the electrode layers wherein the electrode layer adjacent to the piezoelectric is low acoustic impedance aluminum (see e.g. col. 3, lines 13-14) with a mass loading layer that is a material with a higher acoustic impedance such as gold (see e.g. col. 5, lines 37-38), wherein the diffusion barrier is shown as chrome (see col. 3, line 67 and col. 4, line 4) or aluminum oxide (col. 3, lines 29-35) but is also disclosed to include other well known diffusion barrier materials (see col. 3, lines 36-39), which one of ordinary skill would have known included Ti.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified the FBAR of Bradley having resonators with a top electrode thinner than a bottom electrode (Figs. 3A-4), by having provided the electrode layers be stacks of conductors with a low acoustic impedance material of aluminum in contact with the piezoelectric layer and a gold conductive material not in contact with the piezoelectric layer as the mass loading layer, with a diffusion barrier layer therebetween a suggested by the exemplary teaching thereof by Zimnicki (Fig. 2 and col. 3, lines 13-16), because such an obvious modification would have provided the advantageous benefits of reduced spurious responses due to the use of a lightweight

main electrode like aluminum as suggested by Zimnicki (see col. 4, lines 64-67) and simple tuning due to the ease of desputtering of the mass loading layer as also suggested by Zimnicki (col. 3, lines 13-16), and because as noted above, Bradley clearly disclosed its electrode materials as only one possible embodiment (see col. 7, lines 24-31) suggesting that other materials as well (see col. 10, lines 22-27) such as those of Zimnicki would have been usable therewith.

10. Claims 10 and 11 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Bradley et al. U.S. 6,874,211 (of record) in view of Ylilammi U.S. 6,051,907 (of record)[cited by Applicants] for reasons of record as stated in paragraph 12 of the prior Office action.

Response to Arguments

11. Applicants' arguments with respect to claim 1 as amended and the Weber and Zimnicki references were persuasive and these rejections have been withdrawn as noted above.

12. Applicants' arguments with respect to claim 1 and the Bradley reference as applied in the prior § 102 rejection were persuasive but are moot in view of the new grounds of rejection under § 103 (see also the next paragraph).

13. Applicants' arguments filed 4/10/08 regarding the Lakin and Bradley combination with respect to claim 1 have been fully considered but they are deemed not persuasive.

Note that the Lakin in view of Bradley portion of the rejection has been withdrawn.

Applicants' argument that "Bradley fails to teach a top electrode layer that is thinner than a bottom electrode layer" (see page 11 of the response) is considered unpersuasive because the Examiner disagrees with the argument for the reasons fully explained in the new § 103 rejection above based on Bradley alone. That is, while one embodiment may be silent as to the initial thicknesses of both the top and bottom electrodes, it is what the reference as a whole teaches and/or suggests to one of ordinary skill in the art based on all of the embodiments that is pertinent. It is believed to be quite clear to the Examiner and anyone of ordinary skill, that all of Bradley's examples are based on the 1900MHz resonators with initial top and bottom electrode thicknesses of 1,500 Angstroms and piezoelectric layer thickness of 21,000 Angtroms (col. 3, lines 45-51 and col. 9, lines 1-5 as well as col. 6, lines 61-65 and col. 7, lines 44-50) from whence the tuning takes place by either adding a mass loading layer to the bottom electrode (Fig. 4) or thinning the top electrode (Fig. 3A) either of which therefore render the top electrode thinner than the bottom electrode for the leftmost resonator in the figures, such that the two resonators shown in the figures hence have different resonant frequencies. Note that the rightmost resonator in the figures is unchanged and has top and bottom electrodes of equal thicknesses being the original 1,500 Angstroms. This is considered to be extremely obvious from the reference taken as a whole.

14. In the interest of a speedy prosecution, the Examiner suggests that Applicants consider including the function of their invention in the claims since it is clearly not tuning as is the function in the Bradley reference. It should be noted however that the

Examiner is not indicating that Applicants' function is allowable subject matter, as it would require further search and/or consideration, but only that it would appear to overcome the Bradley reference.

Conclusion

15. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Iwasaki et al. U.S. 2006/0220763 does not have an effective filing date that precedes Applicants' earliest effective filing date, but is cited because it covers very similar subject matter (see the abstract, especially the last three lines thereof) and appears to cover the same function of broadening the bandwidth.

16. Any inquiry concerning this communication or earlier communications from the examiner should be directed to BARBARA SUMMONS whose telephone number is (571)272-1771. The examiner can normally be reached on M-Th, M-Fr.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Bob Pascal can be reached on (571) 271-1769. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

bs
July 2, 2008

/Barbara Summons/
Primary Examiner, Art Unit 2817